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Children dating childhood memories

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How accurate are children when dating very long-term memories? Chinese and European Canadian 8-, 11-, and 14-year-olds ($N = 344$) recalled and dated memories from before they went to school in a memory fluency task. Parents provided verification of children's memories and age estimates. Across all age and culture groups, a telescoping effect (i.e., events were dated as taking place more recently than they actually did) was found for earlier memories (before 48 months) and a reverse telescoping effect for later memories (after 48 months). Older children showed a greater tendency to telescope earlier memories and a weaker tendency to reverse telescope later memories than did younger children. Euro-Canadian children showed larger reverse telescoping than Chinese children. These are the first systematic findings concerning the accuracy of children's dating of very long-term memories. They shed new light on the phenomenon of telescoping and have implications for research on childhood amnesia.

Keywords: Childhood memory; Memory dating; Telescoping; Autobiographical memory; Culture.

In everyday life, such as when sharing memories with a friend or a parent, children often need to provide temporal information about when a past event took place. In the research setting, as in studies that examine children's memories of early childhood experiences, the temporal information children provide about the memories (i.e., memory dating) serves as a critical basis for understanding the phenomenon of childhood amnesia—a scarcity of memories from the first 3 years of life and a gradual increase in memory density from ages 3 to 5. The dating information further helps to elucidate the characteristics of encoding and consolidation processes of early memories (Bauer, Burch, Scholin, & Güler, 2007; Jack, MacDonald, Reese, & Hayne, 2009; Peterson, Wang, & Hou, 2009). Yet little is known about the accuracy of children's memory dating and how it is influenced by the age of children at the time of memory encoding and retrieval. The present study addresses this question by examining the dating of early childhood memories among 8-, 11-, and 14-year-olds. It further includes children from European Canadian and Chinese cultural backgrounds to examine the cross-cultural generalisability of children's memory dating.

An intriguing phenomenon, *telescoping*, has been reported in the memory-dating literature. When adults are asked to recall and date

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autobiographical memories from a period of their lives (e.g., the first semester at college or the past 6 months), older memories tend to be postdated; that is, the events are thought to have happened more recently than they actually have (Loftus & Marburger, 1983; Rubin & Baddeley, 1989). This phenomenon is termed telescoping, as it resembles the situation where an object seems closer in distance when viewed through a telescope. On the other hand, a smaller reverse telescoping effect is often observed with more recent memories, where events are thought to have happened earlier or in a more distant past than they actually have and, as a result, they tend to be predated. These dating errors eventually cause the estimated dates to move towards the middle of the target period (Janssen, Chessa, & Murre, 2006; Loftus & Marburger, 1983; Rubin & Baddeley, 1989; Thompson, Skowronski, & Lee, 1988). One can speculate that childhood memories may be particularly prone to the dating errors given their low accessibility and ease of interference (Bauer et al., 2007; Pillemer & White, 1989). And compared with adults, children may be more vulnerable to the dating errors due to their limited knowledge of time and memory dating strategies (Friedman, 2005; Habermas & Bluck, 2000).

Interestingly, the two major factors proposed to account for telescoping lead to different hypotheses for the dating of childhood memories (Huttenlocher, Hedges, & Prohaska, 1988; Rubin & Baddeley, 1989). The first factor is the smaller or less-complete retention for older events from the target period, which are then dated with less precision compared with more recent events. And because all the events being dated have presumably happened during the target period, whenever dating errors occur older events are generally postdated (i.e., telescoping or forward telescoping) and more recent events are generally predated (i.e., reverse telescoping) so that the recollected dates would fall in the requested period. As a result, given their limited retention, forward telescoping of older events always occurs, although often accompanied by weaker reverse telescoping of more recent events. In line with this premise, in dating childhood memories, a greater tendency to telescope earlier events and a weaker tendency to reverse telescope later events should be expected, especially when the memories are recalled and dated at an older age; that is, after more elapsed time.

The second factor is intrusions from events outside the period being asked about, which are recalled as if they have taken place within the period. Events from before the target period are then postdated and events from after the target period are predated. Following this premise, in dating childhood memories a large reverse telescoping effect should be expected because "intrusions can only come from more recent events, not from before birth" (Rubin & Baddeley, 1989, p. 660). The present study tests the two hypotheses, which will provide new insight into the phenomenon of telescoping.

The recently developed "memory fluency task" provided a great opportunity to answer our research questions. In this method participants are asked to recall, within a limited timeframe, as many memories as they can from any period of their lives or from a target period. They then date the memories (Conway & Holmes, 2004; Peterson, Bonechi, Smorti, & Tani, in press; Peterson, Smorti, & Tani, 2008; Wang, Conway, & Hou, 2004). Researchers suggest that this method is optimal for testing the accessibility of memories (Conway & Pleydell-Pearce, 2000). In the current study we asked children to recall, within a timed period, as many memories as they could of events occurring before they went to school. Later, children were asked to date the memories. Children's parents were asked to verify and date each of the memories their children recalled. We focus here on the accuracy of children's memory dating as a function of age at encoding, age at retrieval, and culture. Prior studies have consistently shown that North Americans are able to access earlier childhood memories than Asians (e.g., Mullen, 1994; Wang, 2001, 2003; Wang et al., 2004). There are as yet no cross-cultural data on the accuracy of dating childhood memories. It is thus critical to establish that cultural differences in the age of earliest memories are not due to any systematic cultural differences in dating errors. Considering that Asians and North Americans use similar strategies in dating childhood memories (Mullen, 1994), we expect similar patterns of dating errors between these cultures.

It is important to note that in line with previous research (e.g., Bauer et al., 2007; Bruce, Dolan, & Phillips-Grant, 2000; Jack et al., 2009), we used the information provided by parents to verify children's dating accuracy. Clearly parents' memory dating is subject to errors too; however, there are a number of reasons why parental estimates are likely to be more accurate than

are those of their children. First, children are recalling memories from their very earliest years and at least some of those memories were close to the period in their lives when children are typically first able to demonstrate long-term verbal recall of complex events (Bauer, 2007). In contrast, these memories date from a comparatively recent time in the lives of parents. Second, children are recalling memories from a time when memories are scarce and typically fragmentary, whereas parents are recalling memories from a period of their lives that is likely to have high personal significance and from which they undoubtedly can retrieve a multitude of memories. Furthermore, parents can date memories with greater accuracy than children by utilising more advanced knowledge of time and dating strategies. Parents also have an additional advantage over children for memory dating; namely the observable developmental differences in children's behaviour at various ages. Their memories of specific events recalled by their children may well be embedded in a mesh of memories that date from similar developmental periods of the children's lives.

METHOD

Participants

The participants were 201 Western-European Canadian children from Newfoundland, Canada, and 133 Chinese children from Beijing and Zhejiang, China. An additional 24 Canadian children were not included in this study because their parents were not available to verify their memories. Children were recruited through local schools and were primarily from middle-class backgrounds. They were taking part in a larger study of childhood amnesia. Canadian children included 68 8-year-olds ($M = 7.95$, $SD = .37$; all in grade 2; 33 girls), 59 11-year-olds ($M = 10.94$, $SD = .36$; all in grade 5; 32 girls), and 74 14-year-olds ($M = 14.26$, $SD = .51$; all in grade 8 or 9; 43 girls). Chinese children included 44 8-year-olds ($M = 7.86$, $SD = .52$; all in grade 2; 19 girls), 44 11-year-olds ($M = 10.98$, $SD = .59$; all in grade 5; 24 girls), and 45 14-year-olds ($M = 15.50$, $SD = .65$; all in junior high grade 2 or 3, equivalent to Canadian grade 8 or 9; 25 girls).

Procedure

Native female researchers interviewed children individually once at school. The researcher explained to the children that they would be asked to recall, within 4 minutes, memories of events that happened to them before they went to school. She further emphasised to children that they should think of as many memories as they could. Pilot tests indicated that the 4-minute period works best for children of the current age range, which is sufficient for children to work at their own pace to think of memories and yet not too lengthy to make children feel uncomfortable at the end when they can no longer recall memories. The researcher started the stopwatch as soon as the children began speaking. Once children provided sufficient information about a particular memory, she prompted them to move on to the next one with encouraging remarks ("Yeah, that's great." "Tell me about something else."). The recall period lasted for exactly 4 minutes. Then the researcher asked children to identify their age at the time of each event in years and months. If children only reported years and did not specify months, the researcher asked ancillary questions (in conjunction with knowing the child's date of birth) that would help children determine at what point within that year of age the event occurred (e.g., Was it summer or winter? Near a special occasion like Christmas, their birthday, Halloween, or Chinese New Year, Moon Festival?). Once children provided clues about the time of year, they were asked to translate the information into an age estimate in years and months. The researcher helped them with the calculation whenever necessary. The interview took approximately 30 minutes and was audiotape recorded.

Parents were called between 1 and 4 months (mean delay = 1.5 month) after their children's interview to verify the memories their children had recalled. Each of their children's memories was described and parents were asked whether the event had happened, might have happened, or had never happened. Parents were further asked how old the child was at the time of each memory event with an approximation to the nearest month. Ancillary questions were asked (e.g., whether the event took place in the summer or winter or near a holiday) to help parents narrow down the dating.

RESULTS

Of the total 2165 memories children recalled, approximately 80% were verified by parents as having happened and 16% as possibly having happened. Very few memories (4%) were disputed by the parents. This pattern was consistent overall across Canadian and Chinese samples. To examine children's dating of childhood memories, subsequent analyses focused on the 1529 memories that were verified by parents as having happened and were given age estimates by both parents and children.[1]

The age at encoding was calculated separately for each memory according to parents' and children's dating. The percentage memory distributions as a function of age at encoding based on parents' versus children's dating were significantly different, $\chi^2(36, N = 1529) = 822.61$, $p < .0001$ (see Figure 1). Compared with the distribution based on parents' dating, the one based on children's dating seems more concentrated in the middle of the period; that is, between 48 and 60 months. Notably, given that many children were already in school by age 5, the percentage of memories recalled dropped after 60 months. Before 60 months, however, the distributions show increases in memory accessibility with age, consistent with prior studies of childhood recollections among children and adults (Bauer et al., 2007; Rubin, 2000).

In the following analyses, age estimates provided by parents were used to index the age at encoding (AaE), as a continuous variable. The differences between children's and parents' age estimates (i.e., children's dating – parents' dating) were used to index the dating error. Age at retrieval (AaR) consisted of three levels at ages 8, 11, and 14. Gender showed no effect on dating error in preliminary analysis and was not considered further. Note that there was no overall dating error; parents' mean age estimate was 47.23 months ($SD = 15.55$), and children's mean age estimate was 47.17 months ($SD = 14.21$), with the difference not significantly different from 0, $t = -.18$, $p = .86$.

Because memories were individually dated, the focus of analysis was on memory as the unit of analysis. A 2 (culture) × 3 (AaR) × AaE mixed model analysis using SAS PROC MIXED program (Singer, 1998) was conducted on dating error, with participant being a random factor. Significant main effects of AaE, $F(1, 1203) = 497.82$, $p < .0001$, $\Delta R^2 = .20$, and AaR emerged, $F(2, 1203) = 8.38$, $p = .0002$, $\Delta R^2 = .16$, qualified by an AaE × AaR interaction, $F(2, 1203) = 3.95$, $p = .02$, $\Delta R^2 = .02$. As illustrated in Figure 2, across all three levels of AaR and across both culture groups, memories of younger AaE (i.e., before 48 months) tended to be postdated (i.e., the value of dating errors was positive), whereas memories of older AaE (i.e., after 48 months) tended to be predated (i.e., the value of dating errors was negative). These dating errors moved children's estimated ages towards the middle of the period. Thus there was a telescoping effect for earlier memories and a reverse telescoping effect for later memories. The magnitude of dating errors for earlier memories decreased as the AaE got older, whereas the magnitude of dating errors for later memories increased as the AaE got older. Across the entire sample, the dating errors can be described with a linear function, $y = -0.48x + 22.65$, $r^2 = .29$.

A further examination of the absolute values of dating errors confirmed the pattern of changes in the magnitude of dating errors; that is, errors in dating earlier memories decreased as a function of AaE, whereas errors in dating later memories increased as a function of AaE (see Figure 3). Overall, the absolute value of telescoping ($M = 9.72$ months, $SE = .38$) was marginally larger than that of reverse telescoping ($M = 8.72$ months, $SE = .37$), $F(1, 1318) = 3.03$, $p = .08$, $\Delta R^2 = .03$. The absolute dating errors can be described with a square transformed quadratic function, $y^2 = 2.54x + 0.46(x - 47.23)^2 - 38.97$, $r^2 = .13$.

Next, to explore the AaE × AaR interaction, we conducted additional mixed model analyses to examine the effect of AaR on dating error for earlier and later memories, respectively, followed by Tukey-Kramer HSD tests. Compared with 8-year-olds ($M = 5.22$ months, $SE = .95$; $M = -6.89$ months, $SE = .95$) and 11-year-olds ($M = 4.30$ months, $SE = .71$; $M = -6.85$ months, $SE = .76$), 14-year-olds ($M = 9.62$ months, $SE = .74$; $M = -4.07$ months, $SE = .61$) showed a larger telescoping effect for earlier memories, $F(2, 515) = 9.45$, $p < .0001$, $\Delta R^2 = .15$, and a smaller reverse telescoping effect for later memories, $F(2, 619) = 4.23$, $p = .02$, $\Delta R^2 = .09$. There was no significant difference between the two younger groups (Tukey-Kramer HSD tests, $ps > .05$).

[1] For results pertaining to culture and age effects on the number of memories recalled, content of memories, age at the earliest memory, and the accuracy of the mean age estimate of the earliest memory, see Peterson et al. (2009).

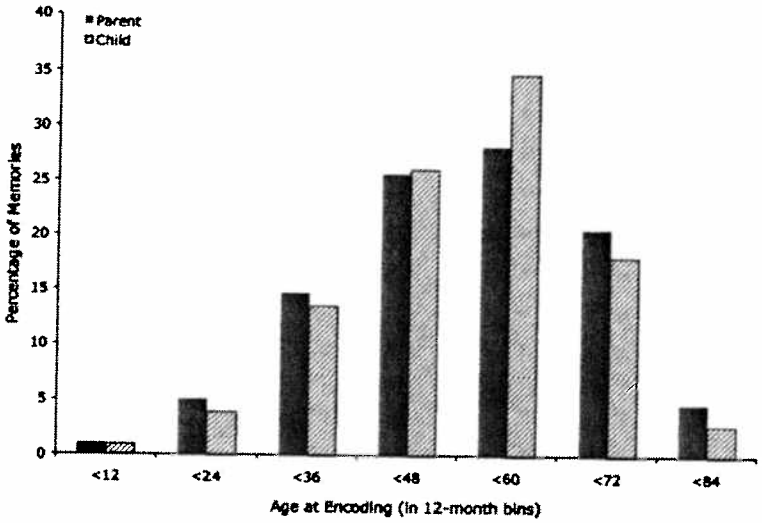

Figure 1. Percentage memory distribution as a function of age at encoding (plotted in 12-month time bins) and parents' versus children's dating.

In addition, the change in the magnitude of dating errors as a function of AaE was greater for 14-year-olds, $y = -0.56x + 28.77$, $r^2 = .39$ (i.e., about .56 months per month), when compared with 8-year-olds, $y = -0.48x + 21.29$, $r^2 = .27$ (i.e., about .48 months per month), and 11-year-olds, $y = -0.41x + 17.90$, $r^2 = .24$ (i.e., about .41 months per month).

In the initial mixed model analysis, Euro-Canadian and Chinese children did not differ in their overall dating errors, $F(1, 316) = 0.26$, $p = .61$, although there was a significant Culture × AaE interaction, $F(1, 1203) = 7.98$, $p = .005$, $\Delta R^2 = .04$. Inspection of the means indicated that children of both groups tended to postdate memories of AaE earlier than 48 months and predate memories of AaE later than 48 months (see Figure 4). To further explore the Culture × AaE interaction, we conducted mixed model analyses to examine the effect of culture on dating error for earlier and later memories, respectively. While children made similar telescoping errors in dating earlier memories, $F(1, 245) = 2.64$, $p = .11$, Euro-Canadian children showed a larger reverse telescoping effect in dating later memories than did Chinese children, $F(1, 285) = 8.60$, $p = .004$, $\Delta R^2 = .04$.

DISCUSSION

The investigation of children's memory dating is not only of theoretical importance but also pertinent to practical issues such as children's eyewitness testimony. The current study is the first to systematically investigate the accuracy of the dating of very long-term memories among children. Previous studies on childhood recollections have verified the mean age estimates provided by participants against the mean age estimates provided by parents or other adults who were present at the time of the events. The studies have then come to the conclusion that there is no overall dating error (e.g., Bruce et al., 2000; Peterson et al., 2009; Rubin, 1982). Indeed, the mean age estimates of memories provided by children and by parents in our study were almost identical. However, when the age at encoding and age at retrieval were taken into consideration, a consistent pattern of dating errors emerged. Telescoping occurred for memories encoded at earlier ages, whereas reverse telescoping occurred for memories encoded at later ages. This was true for both Canadian and Chinese children and across all three of the ages studied.

These findings are provocative and have a number of implications. In terms of theoretical explanations for the phenomenon of telescoping, two major factors have been proposed (Huttenlocher et al., 1988; Rubin & Baddeley, 1989): One involves the greater retention and accuracy of dating for recent events, which should lead to substantial forward telescoping for older events but weaker reverse telescoping for more recent events, and this pattern should be greater for older than younger children. The other factor

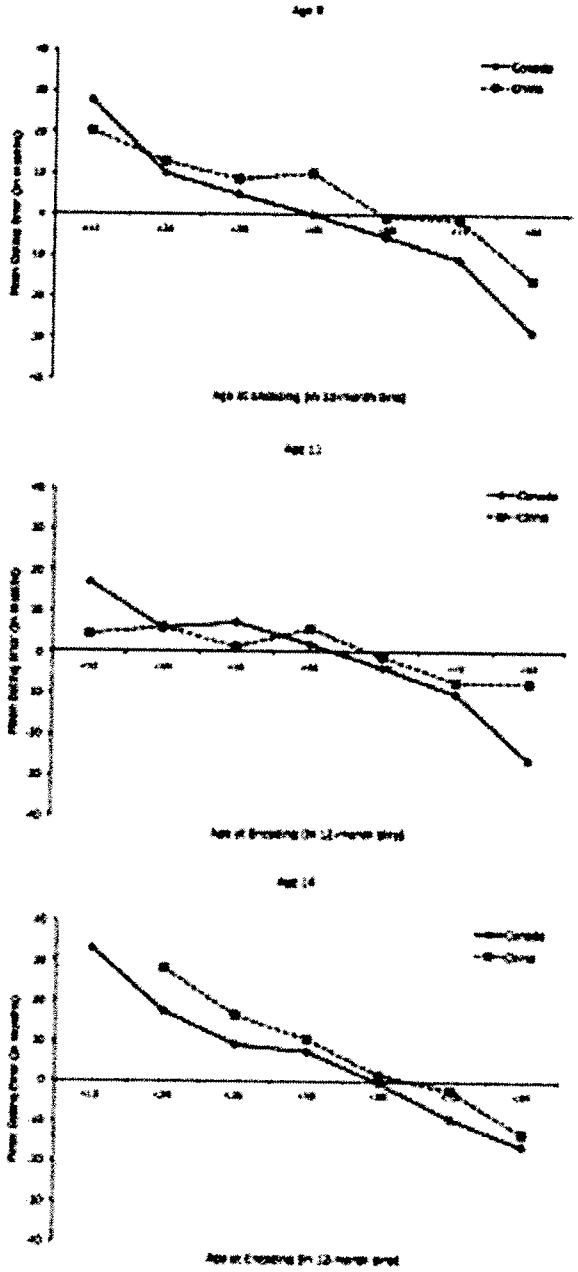

Figure 2. Dating error as a function of age at encoding (plotted in 12-month time bins), age at retrieval, and culture.

involves intrusions from events outside the target period. Since children in the present sample were asked to retrieve their earliest memories, there would be little intrusion from earlier events and thus there should be a substantial reverse telescoping effect although not much of a forward telescoping effect. At the first glance, our findings seem supportive of the retention explanation since dating errors showed considerable forward telescoping and the magnitude was in fact marginally larger than that of reverse telescoping. And children in the oldest age group showed a larger telescoping effect for earlier memories and a smaller reverse telescoping effect for later memories than the younger children.

However, the retention explanation cannot account for the finding that, after the middle of the period, dating errors actually increased for more recent memories. This finding seems to be related to the magnitude of reverse telescoping in

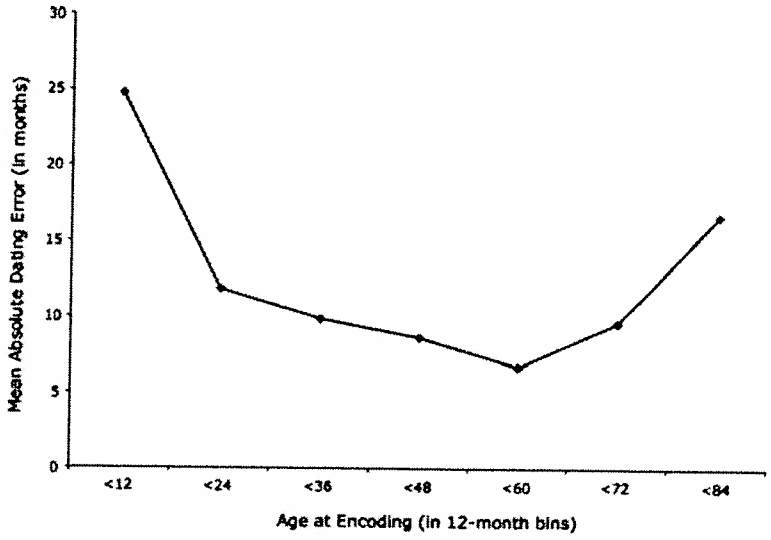

Figure 3. Absolute dating error as a function of age at encoding (plotted in 12-month time bins).

our study, which is considerably larger than what has been previously found, especially in studies where the target period ends at a recent time (e.g., the present, as in research of lifespan retrieval; Janssen et al., 2006; Rubin & Baddeley, 1989). Two factors may account for our findings pertaining to reverse telescoping. First, early childhood memories, including those from later ages, are generally more distant and less well retained than memories from recent adulthood. This may have contributed to the larger reverse telescoping (i.e., greater dating errors) in our study than in previous studies. Second, and perhaps more important, compared with a target period that ends recently, recalling and dating early childhood memories may involve greater intrusions from events taking place after the requested period. And the more recent these intrusive events actually are, the greater they tend to be displaced backward in time, in order to be reported as being within the early childhood period. This may have contributed to the observed pattern where the magnitude of reverse telescoping increased as a function of the age at encoding. Taken together, these data can be best explained by a combination of retention and intrusion factors. Further research will be informative to examine the characteristics of early

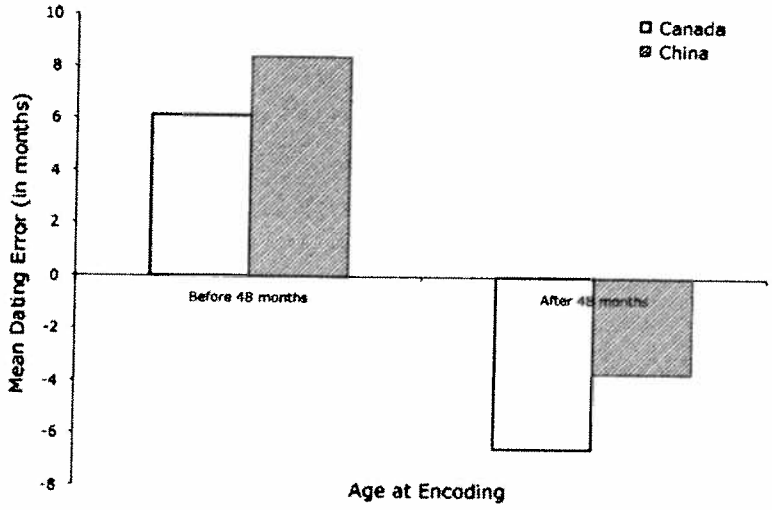

Figure 4. Dating error as a function of age at encoding (before and after 48 months) and culture.

memories such as salience, importance, and prior recollection that may influence the accuracy of memory dating.

These data also have implications for research on childhood amnesia in that they raise the spectre of systematic dating errors for early memories. The largest errors showing telescoping occurred for those memories that were children's earliest. The same phenomenon of telescoping is likely to be present in adults' estimates of their age at the time of their earliest memories too, which calls into question the age of earliest memories commonly reported in the childhood amnesia literature. It points to the importance of establishing the veracity of the age estimates of early memories in future research, particularly by examining the dating accuracy of individual memories rather than the mean age estimate. In addition, these data shed light on the question of whether cross-cultural differences in the age of earliest memories are due to cultural differences in dating errors (e.g., Mullen, 1994; Wang, 2001, 2003). In the present sample children from both Canada and China made similar telescoping errors for their earliest memories, and thus their age at the time of their single earliest memory (a common measure used in childhood amnesia research) was likely to be unaffected by cultural differences in dating errors. However, compared with Chinese children, Canadian children had a greater reverse telescoping effect for later memories, suggesting that they might have over-reported more events from after the early childhood period. This would potentially lead to cultural differences when childhood amnesia is studied using methodologies that elicit multiple memories, such as the cue-word or memory fluency techniques. Nevertheless, given that only two cultures are studied here, these findings are merely suggestive and require considerably more cross-cultural investigation.

An important question to address is the accuracy of parental event dating since it has been used as the gold standard against which children's dating accuracy is verified (e.g., Bauer et al., 2007; Bruce et al., 2000; Jack et al., 2009). Although there are reasons to believe that parents are better able than their children to more accurately date the events taking place during the first years of the children's lives, they may be subject to dating errors as well. On the other hand, we speculate that any dating errors parents made in our study are unlikely to be systematic because parents were simply asked to date the memories their children had recalled. They were not asked to generate and date memories from a specific time period themselves, a usual condition for telescoping and reverse telescoping to occur. Therefore the overall pattern of results should not be affected by the parents' dating errors. Nevertheless, the use of parents' memory dating for verification of children's dating is a limitation of this study. Perhaps future research can use a diary method, and thus there would be a more objective measure of when the events children recalled actually occurred. Of course, the idiosyncratic nature of children's early memories would probably result in a diary entry for only a portion of children's memories. Still, dating errors for that portion could be more reliably calculated than when parental dating is used.

In conclusion, this study provides the first empirical evidence for the accuracy of children's dating of very long-term memories. When children's age estimates of early childhood memories were verified for each memory dated rather than the overall mean estimate, systematic dating errors were identified. A telescoping effect was found for earlier memories and a reverse telescoping effect was found for later memories. The fact that this pattern was consistent across ages and cultures suggests that it is a powerful effect that calls for attention from memory researchers and merits further investigation. The findings may further inform current knowledge of children's understanding and use of temporal information in everyday life as well as in legal settings such as during eyewitness testimony.

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